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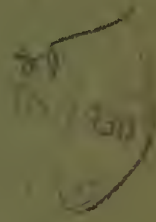
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THE
MONTANA STATE BOARD
OF ENTOMOLOGY

FIFTH
BIENNIAL REPORT

1922-1923



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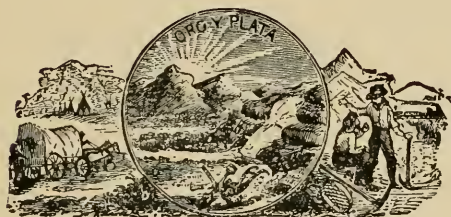
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THE MONTANA
STATE BOARD
of
ENTOMOLOGY



FIFTH BIENNIAL
REPORT

1922 - 1923

MONTANA STATE BOARD OF ENTOMOLOGY

**W. F. COGSWELL, M.D., Secretary State Board of Health,
Chairman, Helena, Montana**

**W. J. BUTLER, D.V.S., State Veterinary Surgeon,
Member, Helena, Montana**

**R. A. COOLEY, B.Sc., State Entomologist,
Secretary, Bozeman, Montana**

LETTER OF TRANSMITTAL

Bozeman, Mont., January 1, 1923

To His Excellency, Joseph M. Dixon,
Governor of Montana,
Helena, Mont.

Sir :—

Acting for the Montana State Board of Entomology, I have the honor to transmit to you the Fifth Biennial Report.

In the preceding report of the Board, attention was directed to the developments in the work which had made it evident that above all else intensive research was needed, in order that we might secure information concerning the real source from which ticks become infected with Rocky Mountain spotted fever. The legislature, however, was unable to make the necessary appropriations for which we had asked, thus placing us in a difficult position. Fortunately, developments in the fever situation in the Bitter Root Valley in the early part of the season of 1921 led to the coming of the United States Public Health Service with a fund to be devoted to research studies. It has, therefore, been possible, by arrangement between the Board and the Public Health Service, for the latter to take up the investigational work on a satisfactory basis and at the same time for the Board of Entomology to continue the destruction of rodents which it has been shown have much to do with the abundance of ticks in the valley, and to carry out other control measures.

It should be pointed out that, while the situation in the Bitter Root Valley has been distinctly relieved, there has as yet been very little accomplished toward the actual eradication of spotted fever. There can be little doubt that the real source of difficulty is back in the mountains which border on the valley and that there exists a set of conditions little understood at present which are responsible for the continued existence of spotted fever in the floor of the valley. Nevertheless, much information of value has been accumulated which, while not of direct value for the immediate control of the disease, is a necessary preliminary to intelligently conducted and effective eradication.

Very respectfully,

R. A. COOLEY, Secretary.

FIFTH BIENNIAL REPORT OF THE STATE BOARD OF ENTOMOLOGY

By R. A. COOLEY, Secretary

Previous to the biennium now closing, the efforts of the Board of Entomology had been devoted almost exclusively to the eradication of the spotted fever tick, *Dermacentor venustus* Banks, in western Montana. In our report of two years ago attention was called to the necessity for beginning rather extended research work into the conditions in nature which favor the continued presence of the spotted fever organism among rodents or other animals in the mountains bordering on the Bitter Root Valley. The legislature was asked for sufficient funds to enable us to take up this study and at the same time to continue the work of rodent destruction which was well under way. The legislature, however, found it impossible to make as large an appropriation as was necessary, and in the spring of 1921 the Board of Entomology laid out its work to make the best use possible of the money that was made available. The investigation work was started, though on a restricted basis, and the control continued on a less extensive scale than in previous seasons.

During the spring months of 1921 there was a sharp increase in the number of cases of spotted fever in the Bitter Root Valley. In 1920 there were only four cases in the counties of Missoula and Ravalli, while in 1921 in these same counties there were eleven. Certain prominent citizens were stricken and the public became thoroughly aroused. An unusual interest in the disease and in the work of this Board became evident. An appeal was made to the United States Public Health Service for assistance, and on the invitation of the Board of Health and the Board of Entomology, this service established a field station in the Bitter Root Valley and started research work. Dr. R. R. Parker, who had held the title of assistant entomologist to the Board of Entomology, was transferred to the pay roll of the Public Health Service and placed in charge. Mr. W. E. Pollinger was employed by the Board and assigned

to the work of rodent control, thereby leaving Dr. Parker free to devote his attention mainly to the investigation. Dr. Parker was in charge until the arrival of Dr. R. R. Spencer, past assistant surgeon in the Public Health Service, who was sent to Montana to take charge of the laboratory in March, 1922. The coming of the Public Health Service into the field resulted in the taking up of the investigational work along even more extensive lines than would have been possible had the full amount requested from the legislature been made available. A large school building on the west side of the river near Hamilton was rented by the service and a laboratory with the necessary equipment was established. The work is now being conducted in this building and it is our hope that this service will continue its work for some years, or until it is completed. The funds from the State of Montana are being devoted to the control work, mainly, and to a small extent are used to help pay certain necessary expenses connected with the research work that can not be charged against Federal funds. The work is well organized and is being pressed with much energy.

The work of controlling rodents and of dipping animals must be continued, but in the light of the experience of the Board it is apparent at the present time that our interests must center around the research work, for it is evident that until we know the source from which the ticks become infected and the factors that perpetuate the disease, we can not do a work of permanent value. The report of Dr. Parker and Mr. Pollinger is given in complete form since it furnishes a full summary of the work that has been done during 1921 and 1922.

THE OCCURRENCE OF SPOTTED FEVER IN MONTANA

During recent years a considerable amount of attention has been given to accumulating reliable data on the number of cases of Rocky Mountain spotted fever throughout the State of Montana. It should be borne in mind that there are two types of the disease in the State. A severe type with a high percentage of fatalities prevails in Missoula and Ravalli counties. A less severe type of infection

occurs in other parts of the State, particularly in the counties east of the mountains. This milder, though by no means not-to-be-dreaded type of the disease has been gradually spreading and the number of cases increasing. At present it is known to occur in at least twenty-eight counties. The mortality rate of this type varies with the locality, but is rarely under 10 per cent and during some seasons is much higher. Although it has only been definitely known in eastern Montana since 1914, residents in certain sections have already learned to fear it and it is becoming more and more common to hear people threaten to move to areas where the infection is not known.

In 1922 there were eight cases, all of them fatal, in Missoula and Ravalli counties, while fifty cases with a mortality rate of over 15 per cent occurred in other sections of the State. The following tables show the number of cases in Missoula and Ravalli counties since 1913 and in other counties since 1914:

**Rocky Mountain Spotted Fever Cases in Counties Other Than
Missoula and Ravalli Beginning in 1914, the First Year
That the Disease Showed a Wide Distribution
Within the State**

Counties	1914	1915	1916	1917	1918	1919	1920	1921	1922
Blaine									1
Broadwater							1	1	0
Big Horn ¹		2				1	1		1
Carbon ²	2	3	1	4	2	1	1		3
Carter		4							
Cascade ¹³		13							
Custer ⁴		6						1 ¹⁷	1
Daniels						1			
Dawson									1
Fallon									2
Fergus ⁵			1	3		2	3	3	6
Gallatin ⁶		2							
Garfield		5	3	1			1	1	6
Golden Valley				1 ⁷				1	1
Granite ⁸			1						
Jefferson									1
Lewis & Clark						1	3	1	
Madison				2	1				
McCone								2	
Musselshell	1	2	6	1	2	1	10	2	8
Park ¹⁰									
Prairie		1		1					
Powell									1
Richland	1								
Powder River ¹¹		4							
Rosebud		3			1 ¹²	1	1	5	4
Stillwater				2					
Treasure		2	1						2
Yellowstone ¹³			1	3 ¹⁴		1			10 ¹⁵
Valley			1						
Totals.....	4	35	15	19	6	9	18	17	49

¹ Two doubtful cases in 1901.

² Seventeen cases between 1894 and 1904; records between 1904 and 1914 incomplete.

³ Brought in from Idaho.

⁴ Uncertain occurrence before 1915.

⁵ Doubtful case in 1904.

⁶ Locality of infection doubtful.

⁷ Brought in from Idaho.

⁸ Earlier cases between 1891 and 1904.

⁹ One case uncertain.

¹⁰ Doubtful case in 1904.

¹¹ Uncertain cases prior to 1915.

¹² Uncertain case.

¹³ Uncertain case in 1904.

¹⁴ Two cases brought in from Wyoming.

¹⁵ Two uncertain cases in 1900.

¹⁶ One of 1922 cases may have come from Stillwater County; another was imported from Wyoming.

¹⁷ Imported from Nevada.

**Rocky Mountain Spotted Fever Cases in Missoula and Ravalli
Counties from 1913 to 1923**

County	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Missoula		5	5	1	1	1	2	2	3	4
Ravalli		7	3	5	5	2	3	2	8	4 ¹
Totals.....	11	12	8	6	6	3	5	4	11	8

¹ One of these was infected in the laboratory.

THE IMPORTANCE OF ROCKY MOUNTAIN SPOTTED FEVER IN MONTANA

There are other diseases prevalent in Montana which are responsible for more sickness and more deaths than Rocky Mountain spotted fever, but this disease, because of the fact that it is not fully understood and because of the high rate of mortality in the western part of the State is responsible for a dread of the disease in the public mind which seriously affects business interests and property values. There can also be no doubt that the presence of spotted fever in Montana is responsible for much misunderstanding, which is very injurious to the State in other parts of the United States. Once the disease is fully understood and effective measures of control and prevention become known, the situation will be materially relieved. However, conditions are such that Montana should give all possible attention to solving the problem as rapidly as possible.

CO-OPERATION OF THE UNITED STATES BIOLOGICAL SURVEY

As in previous years, the Biological Survey has this past season co-operated with the Board of Entomology in the poisoning of ground squirrels on the Bitter Root National Forest bordering on the Bitter Root Valley and also on other public lands. This has been of great assistance to the Board and we are pleased to express our appreciation to this service for the help which they have given.

MISSOULA DISTRICT

During the spring of 1922 the commissioners of Missoula County requested of the Board that control work be started in the LoLo Valley and in the main valley to the north. A fund of \$3,000 for this work was made available. Accordingly, the Board of Entomology, acting under the law which created it, declared an additional control district as follows:

North Boundary—The east and west extension of the township line between townships 13 and 14 north, beginning at the point where this line intersects the Clarks Fork river, thence extending westward to the Montana-Idaho State line.

East Boundary—The Clarks Fork river from its intersection with the north boundary, south to the junction of the Bitter Root and Hellgate rivers, thence south along the Bitter Root river to the Missoula-Ravalli county line.

South Boundary—The east and west extension of the Ravalli county line from its point of intersection with the Bitter Root river west to the Montana-Idaho State line.

West Boundary—The Montana-Idaho State line.



WILLIAM EDWIN GETTINGER

Born, July 16, 1899.

Died, June 30, 1922, of Rocky Mountain spotted fever, contracted while assisting in the investigation of the disease at Hamilton, Mont.

DEATH OF WILLIAM EDWIN GETTINGER

The Board of Entomology is under the painful duty of recording the death of yet another person engaged in a laboratory investigation of Rocky Mountain spotted fever. William Edwin Gettinger contracted the disease by some unknown accident on or about June 15, 1922, while in the employ of the Public Health Service and died after an illness of eight days. Mr. Gettinger is the fourth person to die as a result of spotted fever infection contracted while on duty in investigations intended to increase our knowledge of the disease and save the lives of other human beings. Five have died, if we include Dr. H. T. Ricketts, who died of typhus fever contracted while investigating that disease. This investigation, however, was undertaken on account of the similarity between typhus fever and Rocky Mountain spotted fever and was really a part of the spotted fever investigation.

In full knowledge of the danger to which he was subjected and yet without hesitation Mr. Gettinger entered the work with enthusiasm and continued it with devotion. When he knew that he had contracted the disease he faced the situation with the utmost courage.

Such is the course of true heroism. Always making light of the danger or keeping silent, yet always aware of it, he devoted himself to his duties with energy and ever-increasing skill. When the nature of this obscure disease is fully known and the way is discovered to prevent other human beings from being infected, it will be recorded of William Gettinger and of those others who in like manner have sacrificed their lives in the study of this dread disease, that each was a martyr to the achievement.

FINANCES

The spotted fever work is necessarily a combination of investigation and control. As fast as information is obtained it is applied in control. We are receiving from the State the sum of \$9,600 annually but this is supplemented by the funds from the United States Public Health Service and by certain sums from the county and further by actual costs of rodent control returned by the property owners through the taxes under Chapter 27 of the Sessions Laws of 1919. Following is a statement of the sums used by the Board of Entomology and the Federal Public Health Service in the work in the biennium now closing:

State appropriation for four months to July, 1921.....	\$ 4,200.00
State appropriation, July, 1921, to July, 1922.....	9,600.00
Public Health Service allotment for investigation, September, 1921, to July, 1922.....	20,000.00
Ravalli County for ground squirrel control, season of 1921.....	2,450.00
Red Cross in Missoula County for research expenses not chargeable to Public Health Service funds, July, 1921, to July, 1922.....	1,400.00
Red Cross in Ravalli County for research expenses not chargeable to Public Health Service funds, July, 1921, to July, 1922.....	800.00
Popular subscription in Ravalli County for research expenses not chargeable to Public Health Service funds, July, 1921, to July, 1922.....	600.00
Total in 1921.....	\$39,050.00

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State appropriation, July, 1922, to July, 1923.....	\$ 9,600.00
Public Health Service allotment for investigation, July, 1922, to July, 1923.....	26,000.00
Missoula County for ground squirrel control in Missoula District, season of 1922.....	3,000.00
Ravalli County for ground squirrel control, season of 1922.....	2,450.00
Red Cross in Missoula County for research expense not chargeable to Public Health Service funds, July, 1922, to July, 1923.....	1,400.00
Ravalli County general fund for research expense not chargeable to Public Health Service funds, July, 1922, to July, 1923.....	1,000.00
Red Cross in Ravalli County for research expense not chargeable to Public Health Service funds, July, 1922, to July, 1923.....	400.00
Total in 1922.....	\$43,850.00

The State funds are applied mainly to the control or to the alleviation of the situation so far as is possible under the present state of our knowledge. The investigational work is under the direction of the United States Public Health Service and under their funds.

The Board of Entomology has approved requests for an increased appropriation from the State which has been filed with the Secretary of State. It should be pointed out that the care of health is a State charge, especially where a

menacing situation is as general as is that of Rocky Mountain spotted fever and where there is danger that the fever may spread and produce a most serious condition. We can not, with any justification, let up on the control work. Rather does it need to be intensified. At the same time it is not just that the entire expense of rodent destruction on a given piece of land should be paid by the owner or renter. Chapter 27, session powers of 1919, authorizes the Board to destroy ground squirrels where the owners fail or refuse to do so or in cases where the owners prefer the State to do it for them and charge the expenses back to the land at not to exceed five cents per acre per treatment. This has been done for the past four years. It has become evident that a continuation of the work in the present manner is not going to permanently eradicate the squirrels. They are abundant on all sides of the control districts, in the mountains west of the valley, and in the valley between the districts and the river. Again, there are pieces of land on which five cents per acre per treatment is not nearly enough to do the work effectively and some squirrels are accordingly left to multiply and spread. The land owner is left with the prospect of having to keep up the expense year after year. In the increased appropriations asked for it is contemplated that the farmer shall be relieved of a part of the expense and that the State shall spend such additional amount as is necessary to secure an effective measure of control.

Many farmers wish to avoid the expense of five to ten cents per acre and, therefore, attempt to do the poisoning themselves as allowed by law. Some do not try to do thorough work, while others with good intentions fail to secure results. A reduced cost would mean that more of the work could be done by the State, which with its trained and experienced men can do it more effectively.

Furthermore, the work of control should be extended farther up the valley in the vicinity of Darby. The residents have requested it and the need is evident. This calls for increased expenditure.

ORGANIZATION AND PERSONNEL

The work on spotted fever is organized under an effective and very satisfactory arrangement between the State and the

United States Public Health Service, of which Dr. Hugh S. Cumming, surgeon general, is chief. Dr. R. R. Spencer, Surgeon, is in charge of the field station at Hamilton, and Dr. R. R. Parker, formerly assistant entomologist to the Board of Entomology, is now on the staff of the Public Health Service and is in charge of the field investigations. By this arrangement continuity with the previous investigational work of the Board of Entomology is obtained. The laboratory is organized as follows:

Bureau of the Public Health Service, Research Staff

Dr. R. R. Spencer, Surgeon, United States Public Health Service, in charge of station.

Dr. R. R. Parker, special expert in charge of field investigations.

William E. Gettinger, former laboratory assistant (deceased).

Lawrence H. Dunn, assistant entomologist.

O. M. Salisbury, field assistant.

George H. Cowan, field assistant.

Elmer Greenup, laboratory attendant.

Maud A. Houghlan, clerk.

George H. Michky, janitor.

State Board of Entomology, Control Organization

W. E. Pollinger, field agent, in charge of rodent control.

William Gray, deputy, rodent control, for five months during active season.

R. H. Gagle, field assistant, for temporary investigation studies in co-operation with the Public Health Service.

Maud A. Houghlan, clerk.

PUBLICATIONS

During the biennium the following scientific publication has been prepared:

"Transmission of Rocky Mountain Spotted Fever by the Rabbit Tick, *Haemaphysalis leporis-palustris* Packard," by R. R. Parker. This appeared in the issue of the *American Journal of Tropical Medicine* for January, 1923.

The results of the investigations by the Public Health Service will be printed from time to time in the publications of that bureau. A paper dealing with certain characteristics of the virus of spotted fever in ticks was recently published in the public health reports.

REPORT OF TICK CONTROL OPERATIONS IN THE BITTER ROOT VALLEY DURING THE SEASONS OF 1921 AND 1922

R. R. PARKER, Ph. D.,

Assistant Entomologist, Montana State Board of Entomology, until
September 19, 1921

Special Expert, United States Public Health Service, since
September 19, 1921

and

W. E. POLLINGER, Field Agent,
Montana State Board of Entomology since November 1, 1921

During the present biennium important changes have taken place in the methods of Rocky Mountain spotted fever control and in the manner of its conduct. These changes have been dictated in part by limitations placed upon the work by inadequate funds and in part by the initiation of long-needed research studies. In the latter field, the work was undertaken in a modest way by the State Board of Entomology, beginning in April, 1921, and continued until September of that year, at which time the Federal Bureau of the Public Health Service entered the field and assumed the burden of the major research problems. The service is now conducting the most comprehensive investigation of spotted fever yet undertaken.

Since September 19, 1921, the senior writer has been in the employ of the Public Health Service and has been associated with Surgeon R. R. Spencer of that Service in the research studies. Through the courtesy of the Service he has been permitted to supervise the control work, the junior writer, however, being in immediate charge.

At the last session of the legislature an appropriation of \$22,530 was requested. It was considered that this sum would be sufficient to greatly increase the efficiency of the control procedure and at the same time provide an amount which would permit the starting of much needed investigation studies. (In requesting this money the fact was emphasized that an increase in cases was expected during the seasons immediately to follow. That this prediction was not without basis is witnessed by the fact that during 1921 more cases occurred in the Bitter Root Valley than

for seven years, and that in 1922, the State, as a whole, had the largest number of cases in the history of the disease within its borders). The sum allotted, however, was but slightly more than half that asked for control purposes alone. A radical change was necessary, therefore, in the working plans in order that the money provided might be expended to the best advantage.

In the Fourth Biennial Report, pages 19 to 21, an outline was given of the control program which it was proposed to put into effect, and the reason for each method of attack. This plan involved no new methods but was simply an attempt to amplify and intensify to a point of greater efficiency those already in use. The following main lines of work were to be conducted: (1) Rodent control; (2) grazing control; (3) dipping; (4) quarantine; (5) the handpicking of dairy stock and work horses.

Since the funds allotted were so inadequate a drastic change in the control program was necessary. The rodent control as emphasized in previous reports is the major or most important line of work, the other measures being considered as accessory methods centering around it. In restricting the activities, therefore, it seemed best to center our effort on this phase with the idea that rodent control reasonably well done would at least give as good results as an attempt to carry on the full program with only the means to make it partially effective. It was felt that while this change from the full program meant a lessening of efficiency, yet it would be possible, nevertheless, to at least prevent conditions from going backward. Furthermore, it was possible to avoid the employment of district deputies, of whom five were employed in 1919 and three in 1920. The expense of auto and horse hire for these men was also eliminated. Only the services of Mr. G. H. Cowan, chief deputy, were retained. The regulation requiring the handpicking of stock was retained, although without the district deputies, its execution depended entirely upon the inclination of persons concerned. The quarantine regulation has also been enforced. The enforcement of the latter regulation is important in that it is of value in preventing the shipment of stock carrying infected ticks to other parts of the State or to points outside. Such vats as are in repair

were filled to permit the dipping of stock and for use in connection with quarantine work. The rodent control is the only phase requiring extended discussion and is considered in some detail in subsequent sections of this report.

These changes in the control procedure permitted that a small part of the appropriation be expended for the initiation of a line of investigation, long contemplated, to seek out the factors that are responsible for the maintenance of the virus of Rocky Mountain spotted fever in nature. That such studies would be of real value was soon demonstrated by the discovery that the fever is not only transmitted among rodent life by the fever tick, *Dermacentor venustus* Banks, but also by the rabbit tick, *Haemaphysalis leporis-palustris* Packard. The funds available for this work were, of course, limited and it is indeed fortunate that the Public Health Service was able to come into the field and devote more ample funds to the solution of the problem.

EXPANSION DURING 1921 AND 1922

During the season of 1921 no attempt was made to expand the work. In 1922, however, at the urgent request of the commissioners of Missoula County and the solicitations of the residents in the area concerned, the district in that county was extended to include all the territory between the Bitter Root River and the Montana-Idaho State line, and between the Missoula-Ravalli county line on the south and the north end of the Big Flat on the north.

Of this area active work was necessary on approximately 65,000 acres. This total includes the former O'Brien Creek District of about 15,000 acres. The area on which work was actually performed was increased by about 58,000 acres, the total area now under actual control being approximately 200,000 acres, of which about 145,000 acres are privately owned land.

The inclusion of this territory within the districts makes the control areas continuous for the first time, the districts now extending from Lost Horse Creek on the south, to the Big Flat west of Missoula on the north, a distance of about sixty miles; and at one point, the LoLo canyon, the districts extend thirty miles westward to the Montana-Idaho State line.

The LoLo canyon is included within the territory added this past year. It has been known as one of the worst spotted fever sections, but since the Board of Entomology assumed the burden of control work in 1918, sufficient funds have never been available to permit work in this region. The Federal Bureau of Entomology conducted operations in this canyon for two seasons, 1915 and 1916, but withdrew because of the attitude of the people and the natural obstacles to control. Since then the changed attitude of the residents and the different methods of conducting and financing the work have materially altered the situation.

As noted above, the work in this territory was undertaken at the earnest request of the commissioners of Missoula County and residents of the area. While it has not been feasible up to this year to undertake the work, it was felt incumbent upon us to do so, not only because of the strong public sentiment which demanded it, but also because of the LoLo road project. This road will open up dangerous country to tourist travel and it is incumbent upon the State to make the territory in its vicinity as safe as possible.

Two factors made it possible to take up the work in this region: First, an appropriation by Missoula County, and second, the fact that the Public Health Service had taken over the major portion of the investigation work, thus relieving the Board of Entomology of most of the expense connected therewith.

FUTURE EXPANSION

A conscious effort has been made to keep control operations within limits which could be properly cared for. This has been difficult, however, even though extension has only been made at the earnest solicitations of persons most vitally concerned.

There is before the Board at present a request for expansion southward from Lost Horse Creek to Chaffin Creek, about four miles south of Darby. The inclusion of this area within the districts would bring within the limits of the latter all the farming country which there is any apparent justification for including at the present time.

Thus far it has been necessary to refuse this request, but it is recommended that it now be granted if sufficient funds can be secured to make the additional effort of real value.

RODENT CONTROL

The rodent control work is conducted under the provisions of Chapter 27 of the Sessions Laws of 1919. This law has now been in force for four years, and except as hereafter noted its provisions have proved very satisfactory. It empowers the Board of Entomology to pass regulations requiring the owners of land in the several districts to exterminate ground squirrels or other rodents at such times and by such means as prescribed by the Board. When the owners refuse or neglect to perform the necessary work the Board is empowered to do same through its representatives. To cover the cost of this delinquent work, the county commissioners of any county concerned are authorized to appropriate a sufficient amount from the general fund of the county. The costs on each piece of land can be assessed and collected as taxes, so that all funds expended are returned to the county.

Although the eradication of all rodents from the west side of the Bitter Root Valley would supposedly eliminate all danger of spotted fever, and although at least ten species of rodents are known to be susceptible to spotted fever and capable of infecting ticks, yet this law has only been invoked to compel the destruction of the Columbian ground squirrel. This is for the following reasons: (1) While the almost complete elimination of all rodents may occasionally be possible under localized conditions, it does not at present seem feasible nor financially possible over large areas of the type of country found on the west side of the Bitter Root Valley, nor could the land bear the expense of such extensive operations; (2) when the whole infected area *in the valley proper* is considered, ground squirrels feed the overwhelming majority of the immature ticks; hence, the elimination of this rodent may be expected to eventually result in a corresponding decrease in the abundance of ticks and a salutary effect on the number of fever cases. Since this rodent is also a serious agricultural pest there is a twofold reason for its control.

Until 1921 the rodent control and particularly ground squirrel control, had been the central control activity as explained above, while during 1921 and 1922 it has been the only method employed which has called for financial outlay or considerable expenditure of time on the part of the land owners. Whereas, prior to this time district deputies, under supervision, had charge of the control in each district, employing and discharging their men, assisting in vat work, grazing control operations, etc., the work has since been handled from headquarters with the aid of one assistant.

The extent of the work performed can be judged from the figures in the following tables:

SUMMARY COLUMBIAN GROUND SQUIRREL CONTROL

RAVALLI COUNTY CONTROL DISTRICTS

Year	County Appropriation	Poisoned Once	Poisoned Twice	Quarts Poison	Hours' Labor	No. Baits Put Out	Average Baits Per Acre	Average Cost Per Acre	Additional Poison Purchased by Resident	Poison Spread Without Charge
1919	\$3,500.00	44,396½	40,547½	2,798	4,283	266,611	3.17	.0378	1,204½	.....
1920	3,000.00	48,299	40,983	2,308	4,395	209,521	2.35	.0329	522½	151
1921	2,250.00	48,456.8	38,331	3,025½	3,703	242,032	2.79	.0292	515	200
1922	2,400.00	41,749	44,401	4,760	4,091	380,800	4.42	.0318	1,197	344

RAVALLI COUNTY—FARMS BETWEEN CONTROL DISTRICTS AND BITTER ROOT RIVER

1920	.....	15,460½	.....	819½	828½	75,021	4.85	.0393	152	.....
1921	.....	16,040	.....	1,081	1,091	86,480	5.39	.0473	137	.....
1922	.....	3,160	.....	612½	249	49,000	15.8	.0713	373	45

MISSOULA COUNTY CONTROL DISTRICTS *

1920	\$ 750.00	9,670½	8,930½	581	901	40,905	2.19	.0308	82	.....
1921	500.00	8,301	8,223.1	241.9	555.5	17,352	1.058	.0198	127	.....
1922	3,000.00	66,532	56,070	6,056	4,811	484,480	3.91	.0231	291	.....

RAVALLI COUNTY—FEDERAL LAND² IN CONTROL DISTRICTS

1921	\$ 292.21	6,680	.....	233	.....	.....	.....	.04375	.....	.....
1922	308.96	6,640	.....	448	.....	.....	.....	.04653	.....	.....

MISSOULA COUNTY—FEDERAL LAND² IN CONTROL DISTRICTS

1922	\$ 157.50	3,076		200				.0231		
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NATIONAL FOREST²—RAVALLI COUNTY

1921	\$ 803.40	35,000		777 5-6				.0229		
1922	493.15	40,000		671				.01232		

* Confined to O'Brien Creek District in 1920-1921.

² Funds for Federal land furnished by the Federal Bureau of the Biological Survey.

The aid contributed by the Federal Bureau of the Biological Survey making possible the poisoning of Federal lands within the districts and of a strip of the National Forest immediately adjoining them on the west has greatly enhanced the value of the work. In several instances it has been possible to work back several miles into certain canyons which are particularly dangerous. While this work has covered only a small part of the National Forest it has, nevertheless, decreased migration from the foothills to the valley.

CONTROL OF OTHER RODENTS

While the Columbian ground squirrel work has been the main feature of rodent control, the control of other rodents has only been neglected to the extent dictated by lack of funds. Not only are land owners and residents advised to kill all rodents possible, but all men connected with the work are required to do so, shooting or poisoning as the case may be. The results accomplished in this way, however, leave much to be desired.

The importance of the control of other rodents becomes accentuated in the canyons as they open into the mountains. Here the preponderance of ground squirrels found under valley conditions begins to give way to an increasing proportion of other susceptible rodents, together with an apparent increasing infection in the ticks. It has never been possible to direct adequate attention to these areas.

During the present season, while attempting to develop new poisons for ground squirrels, one made by the simple addition of cracklings to the regular formula was found very effective for woodchucks. These rodents scarcely touch the usual poison distribution for gophers, and the new formula is the only woodchuck poison we have used that is satisfactory under the conditions pertaining to this area. Snowshoe and cottontail rabbits take the regular poison quite satisfactorily during the spring and summer, and all poisoners are instructed to distribute it in rabbit areas whenever possible. Snowshoes can be more economically combatted during the winter months, however, and experiments are being conducted in an attempt to develop a satisfactory winter poison.

POINTS IN WHICH THE RODENT CONTROL WORK IS DEFICIENT AND RECOMMENDATIONS FOR THEIR CORRECTION

The changes in the control procedure made necessary during the past two seasons have been outlined above and it has been pointed out that the present plan is expected to do little more than prevent conditions from going backward. In some areas they should improve. Although this restricted program was originally adopted as a temporary measure because of financial conditions, it is now recommended that it be continued pending the results of the investigation being carried on by the Federal Public Health Service. A part of this investigation concerns the factors which operate to perpetuate Rocky Mountain spotted fever under natural conditions. If it be possible to discover and understand these factors, the control program can be altered in such ways as may be necessary. The recommendation for the continuance of the present plan, however, is made with the idea that every possible effort be made to increase the efficiency of the rodent control and in the following paragraphs the weak places are indicated and certain suggestions made for their correction.

1. Columbian Ground Squirrel Control

One of the most disappointing features of the Columbian ground squirrel work is the unsatisfactory degree of control attainable under the present working conditions in some of the most heavily infested and most dangerous areas. Under the most favorable circumstances this rodent is difficult to control, but in the rough, mountainous areas bordering the Bitter Root Valley, the problem is especially troublesome, and all possible steps should be taken to increase efficiency. The most potent factor operating against efficiency is a financial one, though it is perhaps less a question of amount of funds than of the method by which such funds are obtained and the limitations placed by law on their expenditure.

The law previously referred to, under which the work is now conducted, provides that the land owners, on whose land work is performed by the State, shall pay the cost of labor and material used, the cost per acre, however, not

to exceed five cents per treatment. The State, on the other hand, must bear the cost of supervision, travel, auto mileage, printing, clerical assistance and many miscellaneous items. At the time of enactment it was expected that this arrangement would be satisfactory, but four years' experience has indicated certain defects: (1) The limitation of the cost to five cents per acre is a serious handicap. In many places conditions are such that real results can only be secured at an expenditure considerably in excess of this amount. On such areas, and unfortunately they for the most part are found in the dangerous foothill country, the work is necessarily far from being fully effective. (2) Many land owners attempt to do the necessary work themselves to avoid labor charges. This is usually unsatisfactory; the farmer rarely does thorough work and can not be relied upon to poison his land at the same time the areas adjoining his are being treated. The inability to secure results on the five-cent limit is sometimes due to heavy infestation, sometimes to difficult country to work in, and sometimes to the peculiarities of the squirrels themselves. When infestation has been heavily reduced it is often found that the remaining gophers are "poison-shy." In such cases shooting and other methods are necessary but are now prohibited by the acreage limit. (3) The law requires that assessment records be in the office of the county treasurer concerned on or before August 1st. This is necessary in order that they may be placed on the assessment lists. Because of this the field control must be brought to a close during the first week in July in order to get the records into shape, thus depriving us of one of the best periods of the season for poisoning, namely, that just prior to holing up for the winter. (4) It is now necessary to keep our records on the basis of land ownership. This is unfortunate because many of the records would be extremely valuable if based on permanent units of area such as sections, quarter sections, etc., whereas the constantly shifting of ownership boundaries prevents this under the present system.

Since it is inadvisable to increase the limit of cost per acre and since even if advisable this would only solve a part of the difficulties, it is suggested that some other

means of financing the work be sought other than a direct tax on the land owners. It is therefore recommended that the State, or the counties concerned, or both, assume the major share of the burden of rodent control. The inefficiencies above noted will thus be removed in part and the results secured will then be dependent on the degree of intensive work permitted by the funds available.

In this connection there is a question in the minds of the writers as to just what part of the expense of rodent control is justly chargeable against the land. The benefits of the work are not confined to the west side of the Bitter Root Valley, but directly or indirectly concern the entire State. Furthermore, the situation with regard to the land owner and Rocky Mountain spotted fever is peculiar, in that the basic factor which permits the tick to exist is animate, and not an inherent physical property of land. Furthermore, this animate factor, wild animal life, is one which can only be very slightly affected by any effort of the individual. The individual owner may combat rodents and ticks on his own place with some success, perhaps, but he can not well control rodent movements on to or from his land, nor prevent the carrying of infected ticks by such rodents, nor can any work which he may do affect the amount of infection in the foothills and mountains, from which there is reason to believe that the infection is continually spreading to the valley.

Besides the financial question another factor which affects the efficiency of the work is the matter of supervision. During the past two seasons the person in charge has had but one deputy to assist him, whereas formerly four was the smallest number employed. These men must be supplied with poison, their records collected, their work inspected and their camps moved as necessity requires. Poison must also be distributed to ranchers and their work inspected. Land on which the work has been inefficient must be re-poisoned (at present this can only be done by men on State pay). Besides these duties in connection with the ground squirrel work, the person in charge is responsible for the filling of the vats and testing of solutions, the

enforcing of the quarantine and other miscellaneous duties. It is, of course, apparent that with the control work operating over an area sixty miles long and in one place thirty miles wide, it is impossible for the person in charge, with the aid of one deputy, to efficiently perform the necessary work. The inspection of work performed necessarily suffers since this is the one duty that it is possible to slight. It is, however, very essential to good results. It is recommended that an additional deputy be appointed for a period of four months, from April 1st to August 1st, and that necessary funds be provided for his mileage. While this will not provide the amount of supervision actually needed, it will make it possible to station one deputy in each end of the control area and will be a material help.

2. Control of Other Rodents

As the control of the Columbian ground squirrel makes headway, the necessity for the control of other rodent species is becoming more and more evident. It has been pointed out in a previous section of this report that while the control of the ground squirrel will accomplish more toward tick control *under valley and foothill conditions* than any other one method that it is now *feasible* to employ, yet there are areas scattered throughout the infected districts in which ground squirrels are absent or few in number, and in these areas other rodent species susceptible to the fever are present, take the place of the ground squirrel. It is, therefore, evident that in these areas the ground squirrel work only indirectly affects the abundance of infected ticks. In the valley and foothills these areas are largely occupied by woodchucks, snowshoe rabbits, cottontail rabbits, pine squirrels and chipmunks. It has further been pointed out that in the portions of the mountain canyons that adjoin the valley the ground squirrel which in the foothills and valley exceeds in abundance all other rodents combined (mice excluded), here gives way to their preponderance. Furthermore, the infection in these places is very heavy and can not be greatly reduced by ground squirrel control. Since the canyons are evidently avenues for the valley areas, movement of tick-infested rodents to

valley areas, it is essential that all possible effort be expended in this direction.

While a considerable sum could easily be expended for the control of these other rodents and the work continued throughout the year, at the present time it is only asked that an amount be provided sufficient to keep a crew of three men in the field for a period of three months. It is proposed to use such a crew in selected areas to follow behind the poisoners, killing by shooting and trapping such ground squirrels as are left and killing all possible rodents of other species. This crew would be used for work in the particularly dangerous localities.

VATS

There are within the control areas seven dipping vats. None of these is in good repair and three are unfit for use. It has not been possible to spend sufficient money on their upkeep since the Board took over the control work. They are much used and it is very unfortunate that funds are not available to keep them in proper condition.

Dr. S. B. Wolbach, who formerly contributed materially to our knowledge of Rocky Mountain spotted fever has, with his associates, recently made another distinct and valuable addition. These gentlemen have been able to culture the organism of spotted fever and a copy of his article (Proceedings of the Society for Experimental Medicine and Biology) follows:

THE CULTIVATION OF THE ORGANISMS OF ROCKY MOUNTAIN SPOTTED FEVER AND TYPHUS IN TISSUE CULTURES

S. B. WOLBACH, HENRY PINKERTON and MONROE J. SCHLESINGER
From the Departments of Pathology and Bacteriology,
Harvard Medical School

In these experiments tissues from infected adult guinea pigs were grown in plasma obtained from normal guinea pigs. With Rocky Mountain spotted fever the bits of tissue were taken from the tunica of the testes. With typhus the cerebrad cortex was used. The plasma was obtained from

adult normal guinea pigs by centrifuging chilled blood collected in paraffined tubes.

Our results with spotted fever prove that the virus survives and multiplies in such cultures. Evidence of survival of the virus was obtained by causing the disease in guinea pigs by injecting the cultures intraperitoneally. Although the spotted fever reaction is very characteristic, the results were controlled by histological studies or by subsequent immunity tests.

Evidence of multiplication of the virus was obtained by demonstration of the minute paired micro-organism of the disease (*Dermacentroxenus rickettsi*) in increasing numbers in first general cultures up to about the fourteenth day. The micro-organisms are always intra-cellular, in large amoeboid phagocytic cells of endothelial origin.

The accompanying table shows the duration of survival of the micro-organisms in first "generation" cultures, Experiments of August 17, October 10 and October 24, and the prolongation of this period by transplanting the cultures into fresh plasma, Experiments of October 31 and November 7.

The examination of cultures fixed in Zenker's fluid, sectioned and stained with Giesmsa's stain, shows that the period of survival of the micro-organisms corresponds to the length of survival of the cells of the culture. Initial multiplication of the micro-organisms takes place in situ in endothelial cells of blood vessels and continues in wandering cells of the same origin.

In addition to the forms of the micro-organism previously described, filamentous forms are occasionally found resembling those of *Rickettsia prowazeki* as seen in infected lice.

With typhus we have not completed experiments beyond first "generation" cultures. Guinea pigs inoculated after eight, eleven, and fourteen days incubation of the cultures have acquired typhus, as was proved by typical temperature reaction plus characteristic lesions in the brain or immunity.

Micro-organisms consistent with *Rickettsia prowazeki* have been found in sections of the brain cultures within large wandering amoeboid cells, but their demonstration

is attended with the same difficulties in these tissue cultures as in sections of fresh tissues with lesions. The examination of sections of the cultures shows that the surviving cells in these brain cultures take origin in blood vessels and meninges. Nerve cells and apparently neuroglia cells do not survive. The wandering amoeboid cells, we believe, are of endothelial origin.

The well-known vagaries in duration of incubation periods and intensity of temperature reactions of typhus in guinea pigs render progress slow in these experiments. Our results so far prove that the micro-organism of typhus survives in first "generation" tissue cultures up to fourteen days.

These experiments with both diseases are being continued and extended and in the case of typhus with other tissues than those of the central nervous system.

Explanation of Table

The arrows indicate transfers of the tissue, or fragments thereof into fresh plasma.

‡ Indicates a typical reaction followed by immunity to subsequent inoculation with spotted fever blood.

Guinea pigs C22, C23, C27 were killed.

Guinea pigs C26, C28, C30, C34 and C43 succumbed to the infection.

Guinea pigs C35, C36, C38, C42, C45 and C47 survived the infection.

